**DAW00224**
**Management of barley and barley cultivars in Western Australia**

# 16ES19 The impact of seeding rate on quality and yield of malting barley



| | |
|---|---|
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| **Location of trial** | Grass Patch |



## Summary (Key messages)


- ***Compass had the highest average yield (3.8t/ha), and increasing nitrogen and seeding rate increased yield.***
- ***Grain protein was low across the trial (avg. 8.6%). Only Spartacus CL at 60N and 40pl/m2 (9.6%) or 100pl/m2 (9.5%) met Malt1 specs for grain protein. Varieties didn't differ in their overall protein yield. Increasing SR slightly reduced grain protein (<0.2%).***
- ***Grain sizes were high across the trial, with screenings (<2.5mm) averaging 2.0%.***


## Background

Historically, there has been some level of concern that as plant density increases, there is a risk of a decrease in yield and quality (particularly screenings) that would reduce returns. Previous seeding rate work by the barley agronomy project has determined that these risks of yield decreasing at higher seeding rates is very low, and while screenings have been shown to increase, hectolitre weight decrease and protein concentration decrease with increases in plant density, these are on a small scale.

Growers will focus on maximising returns when growing malt barley and these returns are a function of yield by quality. However, maximum yield and maximum receival quality is unlikely to occur under the same management. Previous work by the barley agronomy project has determined that in >1.5t/ha environments, the target density for malt barley differs by variety, and that target density for sowing barley decreases as N supply increases, and that the optimum management strategy will depend on the variety sown.

However, this work used only a limited range of N rates and seed rates, with the high and low rates often landing outside of malt specifications for grain protein. The best combination of target density and N rate that maximises profit in different current malt varieties is not well understood, especially at environments of a lower yield potential.

## Aim

To determine if the response of current varieties to increases in seed rate and N rate in high rainfall environments apply to lower rainfall environments and to determine the optimum management strategy for new malting cultivars.

## Trial Details

- Property: Danny Sanderson's Grass Patch
- Growing Season rainfall (May to October) = 229 mm (Grass Patch DAFWA Weather Station)
- Soil type: Alkaline shallow loamy duplex
- Previous crop: Canola
- 60 treatments:– 4 varieties x 5 plant densities (40, 100, 160, 220, 280pl/$m^2$) x 3 N rates (10, 30, 60N)
- N application – 1/3 applied banded at seeding, 2/3 as urea spread at stem elongation (except 10N treatment all applied at seeding).
- Sowing date: May 16

| Varieties | Grade |
|---|---|
| Compass | Feed (under malt evaluation) |
| La Trobe | Malt |
| Scope CL | Malt |
| Spartacus CL | Feed (under malt evaluation) |

## Results

By using germination (%), estimated establishment (%) and average grain weights (mg), the target plant densities were relatively well achieved (and actually exceeded) for all treatments. Plant densities averaged 44pl/m2, 118pl/m2, 170pl/m2, 227pl/m2 and 291pl/m2 for the five target densities and there was no difference between varieties in terms of plant establishment.

NDVI (somewhat relative to biomass and greenness) was recorded at 6 weeks after sowing (WAS) and 14WAS. Compass had the highest average NDVI, followed by Scope CL, and then La Trobe and Spartacus CL. Increases in NDVI with increased plant density seen at 6WAS were not evident at 14WAS, although higher N did result in higher NDVI at 14WAS.

Frost assessments were carried out at the site, although no significant damage was recorded. Average head size decreased from 61mm to 46mm as target density increased from 40pl/m2 to 280pl/m2, and grain number decreased from 24 grains per ear to 17. Scope CL had the lowest grain number per ear at 17, compared to 20-21 for the other varieties.

Tiller counts were not conducted at this site, although other work from this season at Wittenoom Hills saw La Trobe and Spartacus CL having more tillers per m2 than Compass and Scope CL, which supports previous observations of these varieties. Despite higher tillering capacity at lower seed rates, overall tillers/m2 increase with increasing seeding rates. At Wittenoom Hills in 2016, there was an average of 511 tillers/m2 at the 75pl/m2 target plant density, increasing up to 664 tillers/m2 at the 300pl/m2 target density.

Plant heights and degree of lodging differed between varieties, with both increasing at higher N rates and plant height decreasing with increased plant density.

Compass was the highest yielding variety at this site, averaging 3.8t/ha compared to 3.4t/ha for the other varieties. As N rate increased from 10N to 60N, yield increased from 3.1t/ha to 4.1t/ha. Increasing plant density from 40pl/m2 to 100pl/m2 increased yield from 3.3t/ha to 3.5t/ha, and then plateaued at 3.6t/ha at the higher seed rates. Varieties did not differ in their yield response to seeding rate or nitrogen rate at this site.

Physical grain quality was good at this site, with hectolitre weight averaging 75kg/hL and screenings (<2.5mm) averaging 2.0%. At this site, increasing plant density from 40pl/m2 to 280pl/m2 reduced hectolitre weight by <1kg/hL and increased screenings by <0.5%. Higher N increased both screenings and hectolitre weight slightly. Compass had a lower hectolitre weight than the other varieties, lowest screenings, and highest average grain weight (equal to Scope CL). On average, increasing plant density decreased grain weight by up to 3mg.

Grain protein concentration was below Malt1 limits for most of the trial, with a trial average of 8.6%. Increasing N from 10N to 60N increased protein from 8.3% to 9.0%. Although varieties differed in their average grain protein (from Spartacus CL at 9.1% to Compass at 8.2%), they did not differ in protein yield, a measure of kg of protein yielded per hectare that takes into account yield dilution. Increasing plant density slightly decreased grain protein (by a maximum of 0.2%) but actually increased protein yield due to increased grain yield at higher seeding rates.

Grain brightness was high across the trial (average 63.1 '*L').

Table 1 Soil analysis at Grass Patch in 2016

| **Depth (cm)** | 0-10 | 0-15 | 15-30 | 30-45 |
|---|---|---|---|---|
| pH (CaCl2) | 6.2 | 7.2 | 8.5 | 8.7 |
| pH (water) | 7.2 | | | |
| Total P (µg/g) | | 71 | 39 | 33 |
| P (HCO3) (µg/g) | 20 | 18 | 6 | 3 |
| K (HCO3) (µg/g) | 253 | 280 | 780 | 810 |
| Total N (%) | | 0.043 | 0.026 | 0.019 |
| N (NH4) (µg/g) | 8 | 4 | 2 | <1 |
| N (NO3) (µg/g) | 7 | 5 | 6 | 5 |
| S (µg/g) | 5.0 | | | |
| Organic carbon (%) | 0.70 | 0.63 | 0.31 | 0.26 |
| PRI (mL/g) | | 8.1 | 61 | 50 |
| PBI | 16.5 | | | |
| Reactive iron (µg/g) | 259.2 | | | |
| Reactive Aluminium (µg/g) | 663.30 | | | |
| Conductivity (dS/m) | 0.074 | | | |
| Soil colour | BRGR | | | |
| Hand texture | 2.0 | | | |
| Clay (%) | | 12.5 | 35.5 | 37.5 |
| Gravel (% by weight) | 0 | | | |
| B (CaCl2) (µg/g) if pH>7.5 | | | 8.7 | 12 |

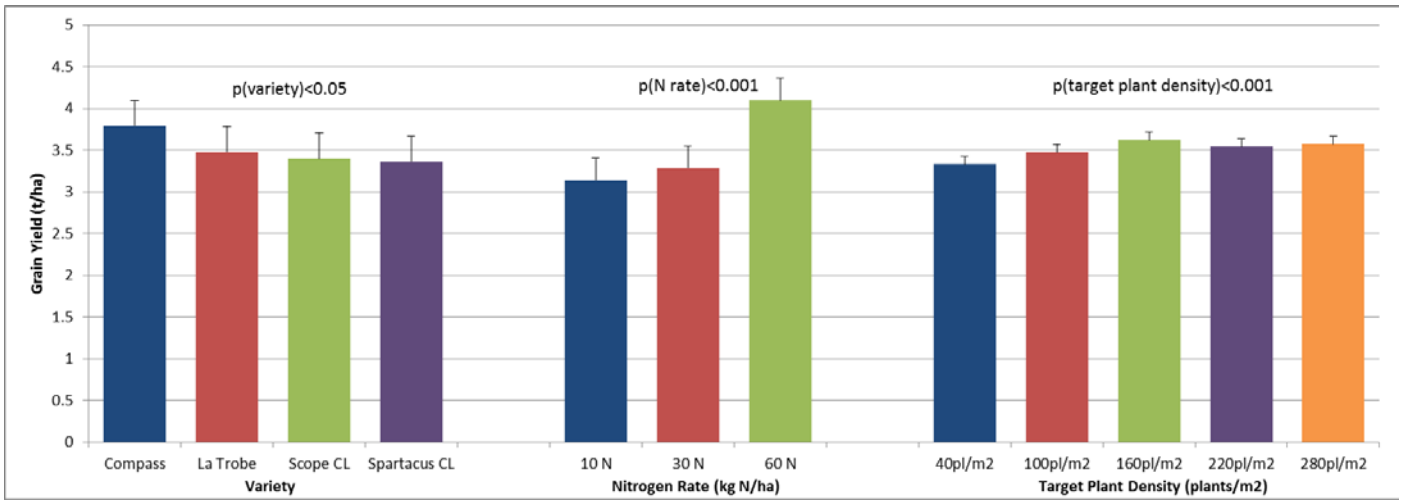


Figure 1 Grain yield of barley at Grass Patch in 2016. Variety, target plant density and N rate treatments were significant. There were no significant interactions for yield between treatments (variety, seed rate or N rate).

Table 2 Physical grain quality and growth traits averaged across the four varieties. All of these measures were significantly affected by increasing the target plant density. Lodging score denotes rating of lodging, 1-severely lodged to 9-no lodging.

| | Target plant density (plants/m2) | | | | | |
|---|---|---|---|---|---|---|
| | 40 | 100 | 160 | 220 | 280 | LSD(0.05) |
| Head length (mm) | 61.3 | 53.8 | 49.5 | 47.6 | 46.4 | 1.9 |
| Grains/ear | 23.7 | 20.6 | 19.0 | 18.0 | 17.4 | 0.9 |
| Plant height (cm) | 61 | 59 | 58 | 56 | 55 | 1 |
| Lodging score | 8.0 | 8.1 | 8.2 | 8.1 | 8.2 | 0.1 |
| Average grain weight (mg) | 45.3 | 43.7 | 43.1 | 42.7 | 42.3 | 0.3 |
| Hectolitre weight (kg/hL) | 75.1 | 75.0 | 74.8 | 74.6 | 74.3 | 0.3 |
| Screenings (<2.5mm) | 1.8 | 1.9 | 2.0 | 2.1 | 2.2 | 0.2 |

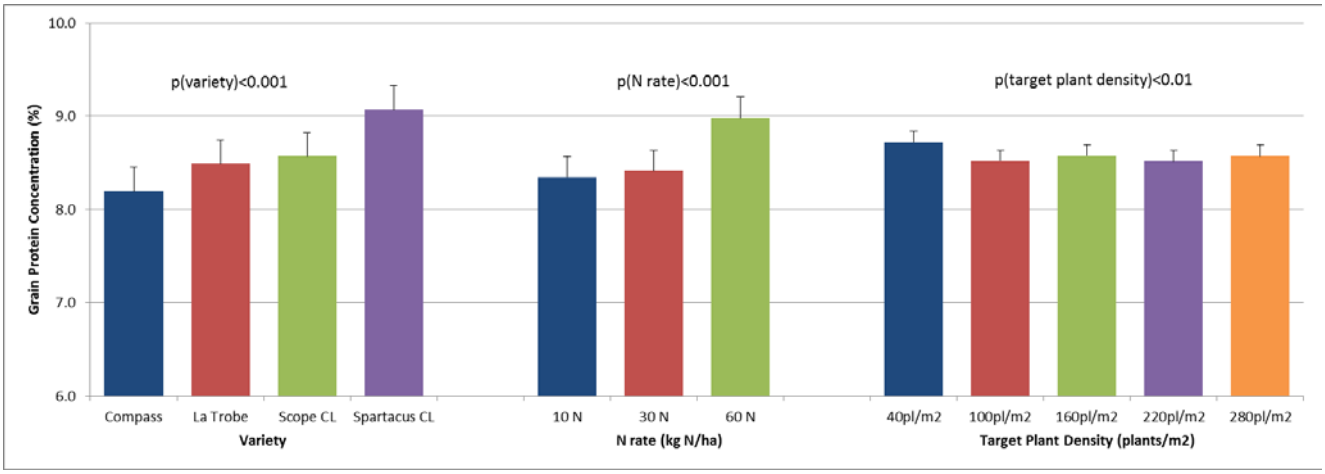


Figure 3 Grain protein concentration of variety, N rate and plant density at Grass Patch in 2016. Variety, target plant density and N rate treatments were significant. There were no significant interactions for yield between treatments (variety, seed rate or N rate). There was no difference between varieties in grain protein yield, a measure that takes into account yield dilution of grain protein concentration (data not shown).

## Conclusion

The results of this trial match up with previous work in the seeding rate space on barley. While this trial series (other sites in 2016: Cadoux, Merredin, Varley (frosted) and Wongan Hills) was intended to determine whether the observations made at higher rainfall areas held true at lower yields, with the way that the 2016 season played out most of these sites averaged well over 3t/ha.

As with previous seeding rate work, increasing seeding rate at Grass Patch in 2016 increased yield, with a modest decrease in physical quality (screenings, hectolitre weight). Paynter et al. (2016) assessed barley varieties at plant densities from 50pl/m2 to 400pl/m2 in 24 trials. In only one trial did grain yield not increase when plant density was increased above 50pl/m2, and on average this increase was 10% to 100pl/m2, and a further 4% to 200pl/m2. In the same trials, as plant density increased from 50pl/m2 to 400pl/m2, hectolitre weight decreased by less than 0.5kg/hl and screenings increased by less than 3%.

The response at Grass Patch in 2016 were similar to these; grain yield increased by 4% when plant density increased from 40pl/m2 to 100pl/m2, and by another 3% when increased to 160pl/m2 or higher. Hectolitre weight decreased by <1kg/hL and screenings increased by <0.5% when plant density increased from 40pl/m2 to 280pl/m2.

Although varieties typically don't differ in their response to increased seeding rate in terms of yield, there is some difference in their grain quality response as seeding rate increases. For example, at Grass Patch in 2016, Compass didn't increase in screenings as plant density increased, La Trobe and Spartacus CL increased by 0.4% from lowest density to highest, while Scope increased by 0.8%. This difference in varietal susceptibility to downgrades from grain quality that was seen in other trials lead varietal specific recommendations.

Paynter et al. (2016) compared returns ($/ha) for different varieties at different plant densities across 24 trials. Some varieties (e.g. Bass, Flinders, La Trobe) had stable returns across 100-200pl/m2, and so a target density of 150pl/m2 is recommended. Other variteies (e.g. Baudin, Buloke, Granger) were dropped

off returns at 200pl/m2 and so a target plant desnsity of 120pl/m2 was recommended. Feed varieties were recommended at 180pl/m2 to maximise yield and increase competition with weeds.


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